

# JAPAN

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JIS B 9703 (2011) (English): Safety of machinery  
-- Emergency stop -- Principles for design

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*The citizens of a nation must  
honor the laws of the land.*

Fukuzawa Yukichi

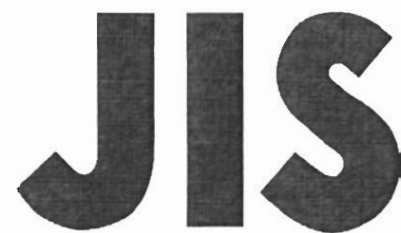
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**Safety of machinery—Emergency  
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## Contents

	Page
Introduction.....	1
1 Scope.....	1
2 Normative references .....	2
3 Terms and definitions .....	2
4 Safety requirements .....	3
4.1 General requirements .....	3
4.2 Electrical emergency stop equipment requirements .....	4
4.3 Operating conditions, environmental influences .....	4
4.4 Emergency stop device.....	4
4.5 Use of wires or ropes as actuators .....	6

## Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Health, Labour and Welfare and the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by the Japan Machinery Federation (JMF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS B 9703**:2000 is replaced with this Standard.

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Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public or utility model right. The relevant Ministers and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public or utility model right.

## Safety of machinery—Emergency stop— Principles for design

### Introduction

This Japanese Industrial Standard has been prepared based on the second edition of **ISO 13850** published in 2006 without modifying the technical contents.

The structure of safety standards in the field of machinery is as follows.

Type-A standards (basis standards) give basic concepts, principles for design, and general aspects that can be applied to machinery.

Type-B standards (generic safety standards) deal with one or more safety aspect(s) or one or more type(s) of safeguard that can be used across a wide range of machinery.

Type-B1 standards on particular safety aspects (e.g. safety distances, surface temperature, noise).

Type-B2 standards on safeguards (e.g. two-hands controls, interlocking devices, pressure sensitive devices, guards).

Type-C standards (machinery safety standards) deal with detailed safety requirements for a particular machine or group of machines.

This Standard is a type-B2 standard.

However, major deviations in this Standard are as follows.

- Reset the emergency stop command manually (see **4.1.6**).
- Apply mechanical latching to the emergency stop device (see **4.4.3**).

### 1 Scope

This Standard specifies functional requirements and design principles for the emergency stop function on machinery, independent of the type of energy used to control the function.

It is applicable to all machinery except for:

- machines in which the provision of emergency stop would not lessen the risk;
- hand-held portable machines and hand-guided machines.

It does not deal with functions such as reversal or limitation of motion, deflection, shielding, braking or disconnecting, which can be part of the emergency stop function.

**NOTE :** The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows:

ISO 13850:2006 *Safety of machinery—Emergency stop—Principles for design* (IDT)

The symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.



## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 9700-1 *Safety of machinery—Basic concepts, general principles for design—Part 1: Basic terminology, methodology*

NOTE : Corresponding International Standard: ISO 12100-1 *Safety of machinery—Basic concepts, general principles for design—Part 1: Basic terminology, methodology* (IDT)

JIS B 9960-1 *Safety of machinery—Electrical equipment of machines—Part 1: General requirements*

NOTE : Corresponding International Standard: IEC 60204-1 *Safety of machinery—Electrical equipment of machines—Part 1: General requirements* (MOD)

JIS C 8201-5-5 *Low-voltage switchgear and controlgear—Part 5-5: Control circuit devices and switching elements—Electrical emergency stop device with mechanical latching function*

NOTE : Corresponding International Standard: IEC 60947-5-5 *Low-voltage switchgear and controlgear—Part 5-5: Control circuit devices and switching elements—Electrical emergency stop device with mechanical latching function* (IDT)

IEC 60417-DB *Graphical symbols for use on equipment* (online database)

## 3 Terms and definitions

For the purposes of this Standard, the terms and definitions in **JIS B 9700-1** and the following apply.

### 3.1 emergency stop, emergency stop function

function that is intended to

- avert arising, or reduce existing, hazards to persons, damage to machinery or to work in progress,
- be initiated by a single human action

NOTE : Hazards, for the purposes of this Standard, are those which can arise from

- functional irregularities (e.g. machinery malfunction, unacceptable properties of the material processed, human error),
- normal operation

(See 3.37 of **JIS B 9700-1**.)

### 3.2 emergency stop device

manually actuated control device used to initiate an emergency stop function

(See 3.2 of **JIS C 8201-5-5**.)

### **3.3 machine actuator**

power mechanism used to effect motion of the machine

(See **3.34** of **JIS B 9960-1**.)

### **3.4 safety function**

function of a machine whose failure can result in an immediate increase of risk(s)

(See **3.28** of **JIS B 9700-1**.)

## **4 Safety requirements**

### **4.1 General requirements**

**4.1.1** The emergency stop function shall be available and operational at all times and override all other functions and operations in all operating modes of the machine without impairing any facilities designed to release trapped persons.

It shall not be possible for any start command (intended, unintended or unexpected) to be effective on those operations stopped by the initiation of the emergency stop function until the emergency stop function is manually reset.

When emergency stop devices can be disconnected (e.g. portable teaching pendants) or when machinery can be partially isolated, care should be taken to avoid confusion between active and inactive control devices.

**4.1.2** The emergency stop function shall not be applied as a substitute for safeguarding measures and other safety functions but should be designed for use as a complementary protective measure. The emergency stop function shall not impair the effectiveness of protective devices or of devices with other safety functions.

NOTE : For this purpose, it can be necessary to ensure the continuing operation of auxiliary equipment such as magnetic chucks or braking devices.

**4.1.3** The emergency stop function shall be so designed that, after actuation of the emergency stop actuator, hazardous movements and operations of the machine are stopped in an appropriate manner, without creating additional hazards and without any further intervention by any person, according to the risk assessment.

An “appropriate manner” can include

- choice of an optimal deceleration rate,
- selection of the stop category (see **4.1.4**), and
- employment of a predetermined shutdown sequence.

The emergency stop function shall be so designed that a decision to use the emergency stop device does not require the machine operator to consider the resultant effects.

**4.1.4** The emergency stop shall function in accordance with either of the following stop categories.

- a) **Stop category 0** Stopping by means of
- immediate removal of power to the machine actuator(s), or
  - mechanical disconnection (declutching) between the hazardous elements and their machine actuator(s) and, if necessary, braking.
- b) **Stop category 1** A controlled stop with power to the machine actuator(s) available to achieve the stop and then removal of power when the stop is achieved.

Examples of the removal of power include

- switching off the electrical power to the electric motor(s) of the machine,
- declutching the movable elements of the machine from the source of mechanical energy, and
- blocking the fluid power supply to the hydraulic/pneumatic machine actuators of the machine.

**4.1.5** The choice of either stop category 0 or 1, according to **4.1.4**, shall be determined by the risk assessment of the machine (see also **9.2.5.4.2** of **JIS B 9960-1**).

NOTE : Requirements for safety-related functions can be found in **JIS B 9705-1** and **JIS B 9961**, among others.

**4.1.6** Once active operation of the emergency stop device has ceased following an emergency stop command, the effect of this command shall be sustained until it is manually reset. Reset shall be possible only at that location where the emergency stop command was initiated. The reset of the command shall not restart the machinery but only permit restarting. It shall not be possible to restart the machine until a manual reset of the emergency stop device has been performed at each location at which the emergency stop was activated.

## **4.2 Electrical emergency stop equipment requirements**

Electrical equipment used for emergency stop shall be in accordance with the relevant requirements of **JIS B 9960-1**. For the requirements relating to emergency stop devices, see **4.4** and **JIS C 8201-5-5**.

## **4.3 Operating conditions, environmental influences**

The components, devices and elements used to achieve the emergency stop function shall be selected, assembled, interconnected and protected such that they are able to operate correctly under the expected operating conditions and environmental influences, including taking into consideration

- the frequency of operation and need for periodic testing, for example, in the case of infrequent operation, and
- the effects due to, for example, vibration, shock, temperature, dust, foreign bodies, moisture, corrosive materials and fluids.

## **4.4 Emergency stop device**

**4.4.1** The emergency stop device shall be designed to be easily actuated by the operator and others who could need to actuate it.

The types of actuators that may be used include the following:

- mushroom-type pushbuttons;
- wires, ropes, bars;
- handles;
- in specific applications, foot-pedals without a protective cover.

**4.4.2** An emergency stop device shall be located at each operator control station, except where the risk assessment indicates that this is not necessary, as well as at other locations, as determined by the risk assessment. It shall be positioned such that it is readily accessible and capable of non-hazardous actuation by the operator and others who could need to actuate it. Measures against inadvertent actuation should not impair its accessibility.

**4.4.3** The emergency stop device shall apply the principle of direct opening action with mechanical latching. Electrical emergency stop devices shall be in accordance with **JIS C 8201-5-5**.

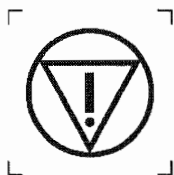
NOTE : An example of the application of this principle is an emergency stop device employing electrical contacts having direct opening action. According to **JIS C 8201-5-5**, Annex K, direct opening action (of a contact element) is the achievement of contact separation as the direct result of a specified movement of the switch actuator through non-resilient members (for example, not dependent upon springs).

**4.4.4** In the case of failure in the emergency stop device (including sustaining function), generation of the stop command shall have priority over the sustaining function. Resetting (e.g. disengaging) of the emergency stop shall only be possible as the result of a manual action at the location where the emergency stop was activated.

**4.4.5** The actuator of the emergency stop device shall be coloured RED. As far as a background exists behind the actuator and as far as it is practicable, the background shall be coloured YELLOW (see **10.7.3** of **JIS B 9960-1**).

NOTE : When using wires or ropes, it can be useful to improve their visibility by attaching marker flags to them.

**4.4.6** Where labels are provided, the symbol **IEC 60417-5638** (DB:2002-10) shall be used, see figure 1.



**Figure 1 Symbol for emergency stop (IEC 60417-5638)**

NOTE : Figure 1 is cited from **IEC 60417-DB** in clause 2.



#### 4.5 Use of wires or ropes as actuators

**4.5.1** When wires or ropes are used as the actuators of emergency stop devices, they shall be designed and positioned for ease of use. For this purpose, consideration shall be given to

- the amount of deflection necessary for generating the emergency stop command,
- the maximum deflection possible,
- the minimum clearance between the wire or the rope and the nearest object in the vicinity,
- making wires or ropes visible for the operators (e.g. by use of marker flags), and
- the force to be applied, and its direction in relation to the wire or rope, to actuate the emergency stop device.

NOTE : When it is likely that actuation will be attempted by pulling the wire along its axis, it is necessary to ensure that pulling the wire in either direction will generate the emergency stop command.

See **JIS C 8201-5-5**.

**4.5.2** Measures shall be implemented to avoid hazards caused by breakage or disengagement of the wire or rope (see **4.4.4**).

**4.5.3** The means to reset the emergency stop device should be placed so that the whole length of the wire or rope is visible from the location of the resetting means.

**4.5.4** The instructions for use shall state that, after actuation and before resetting, the machinery shall be inspected along the whole length of the wire or rope in order to detect the reason for activation.

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#### Bibliography

- [1] JIS B 9705-1 *Safety of machinery—Safety-related parts of control systems—Part 1: General principles for design*

NOTE : Corresponding International Standard: ISO 13849-1 *Safety of machinery—Safety-related parts of control systems—Part 1: General principles for design* (IDT)

- [2] JIS B 9961 *Safety of machinery—Functional safety of safety-related electrical, electronic and programmable electronic control systems*

NOTE : Corresponding International Standard: IEC 62061 *Safety of machinery—Functional safety of safety-related electrical, electronic and programmable electronic control systems* (IDT)

- [3] JIS C 8201-5-1 *Low-voltage switchgear and controlgear—Part 5-1: Control circuit devices and switching elements—Electromechanical control circuit devices*

NOTE : Corresponding International Standard: IEC 60947-5-1 *Low-voltage switchgear and controlgear—Part 5-1: Control circuit devices and switching elements—Electromechanical control circuit devices* (IDT)

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**Standards Publishing Department, Japanese Standards Association**

4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

TEL. 03-3583-8002 FAX. 03-3583-0462